PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of:

Application No.:	10/544,182	**Examiner:**	8333
Filing Date:	October 4, 2006	**Art Unit:**	1791
First Inventor:	Klaus Habik	**Customer No.:**	23364
Attorney No.:	HABI3001/JJC/PMB	**Confirm. No.:**	Cordray, Dennis R.
For:	**SECURITY PAPER AND METHOD FOR THE PRODUCTION THEREOF**		

APPEAL BRIEF

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is an appeal brief filed pursuant to the applicant's appeal to the Board of Patent Appeals and Interferences from the final rejection of claims on September 27, 2010, and the Advisory Action dated January 6, 2011 in the above identified application.

The filing of this appeal brief is made within two months of the filing of the Notice of Appeal on January 26, 2011 and is therefore timely.

I. **REAL PARTY IN INTEREST**

The real party in interest is the assignee of record: GIESECKE & DEVRIENT GMBH (Munchen, Germany).

II. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

A. Status of Claims in Proceeding

Claims 1-4, 10-15, 17-33, and 35-47 are currently pending in the above-identified application.

Claims 1-4, 11-15, and 17-26 are rejected under 35 U.S.C. § 103(a).

Claims 5-9, 16, and 34 are canceled.

Claim 10 is objected to as being dependent upon a rejected base claim, but apparently would be allowable if rewritten in independent form to include all of the features of the base claim from which it depends and all of the features of any intervening claims.

Claims 27-33 and 35-37 are withdrawn.

B. Identification of Appealed Claims

The applicant chooses to appeal from the rejection of claims 1-4, 11-15, and 17-26.

Claims 2-4, 11-15, and 17-26 depend from claim 1, and their patentability is based on their dependency from claim 1 and their individually recited features.

A copy of all the pending (non-withdrawn) claims as presented in the last entered amendment dated December 27, 2010 is included in the attached Claims Appendix.

IV. STATUS OF AMENDMENTS

There are no outstanding amendments to the claims. The last amendment to the claims was filed on December 27, 2010, and was entered for purposes of appeal in the Advisory Action dated January 6, 2011.

V. SUMMARY OF CLAIMED SUBJECT MATTER

For the purposes of appeal, the rejections of claims 1-4, 11-15, and 17-26 are appealed.

A. Independent claim 1

Pending claim 1 requires a security paper for producing value documents, exemplified by bank notes, passports or identification documents, (10, Figures 1-2; paragraphs [0001], [0027]) comprising a flat substrate (12, Figures 1-4; paragraphs [0004], [0010], [0013], [0028], [0030], [0033], [0047], [0050], [0051]) provided at least partly with a dirt-repellent protective layer for extending the life time and fitness for circulation (14, Figures 14; paragraphs [0001], [0008], [0010], [0047], [0051]).

The protective layer (14) comprises at least two lacquer layers (16, 18, Figures 1-4; paragraphs [0010], [0047]), a first lower one of said lacquer layers (16) being formed by a physically drying liquid lacquer layer applied to the substrate which makes contact with the substrate therebelow and closes its pores (16, Figure 1; paragraphs [0010], [0011], [0012], [0014], [0028], [0047], [0048]), and a second upper one of said lacquer layers protecting the substrate from physical and chemical influences (18, Figures 1-4; paragraphs [0010], [0012], [0015], [0028], [0049]).

The first lower lacquer layer is based on a water-based dispersion of aliphatic polyester polyurethanes or styrene-acrylic polyurethanes (16, Figures 1-4; paragraphs [0014], [0038], [0041], [0050]).

The second upper layer is formed as any one of the following layers a), b), or c):

a) a radiation-curing UV-crosslinked lacquer layer (18, Figures 1-4; paragraphs [0015], [0039], [0047]);

b) a physically drying water-based dispersion lacquer layer based on styrene-acrylic without a polyurethane component (18, Figures 1-4; paragraphs [0018], [0041]);

c) a hybrid lacquer layer containing both physically drying components and a radiation-curing lacquer component, and based on aqueous dispersions on the basis of aliphatic urethane acrylates and acrylates with photoinitiators (18, Figures 1-4; paragraphs [0019], [0040]).

B. Dependent claims

Pending claim 2 requires the security paper as discussed above with respect to claim 1 and further includes the substrate (12) being formed by an unprinted or printed cotton paper (paragraph [0013]).

Pending claim 3 requires the security paper as discussed above with respect to claim 1 and further includes the lower lacquer layer forming a smooth and contiguous layer on the substrate (paragraph [0014]).

Pending claim 4 requires the security paper as discussed above with respect to claim 1 and further includes the first lower lacquer layer being elastic so as to at least avoid cracks from forming therein through mechanical motions (paragraph [0014]).

Pending claim 10 requires the security paper as discussed above with respect to claim 1 and further has the second upper lacquer layer further including silicones and/or wax (paragraph [0015]). Claim 10 has not been rejected as being anticipated by or as being obvious over prior art references.

Pending claim 11 requires the security paper as discussed above with respect to claim 1 and further requires the UV-crosslinked lacquer layer to be based on an acrylate system (paragraph [0050]).

Pending claim 12 requires the security paper as discussed above with respect to claim 1 and further requires that the composition of the upper lacquer layer is selected with respect to brittleness and surface tension so as to obtain a predetermined haptics of the security paper, in particular a predetermined smoothness, and/or flexural stiffness (paragraphs [0016], [0049]).

Pending claim 13 requires the security paper as discussed above with respect to claim 1 and further requires the second upper lacquer layer to be disposed directly on the first lower lacquer layer (Figures 1-4; paragraph [0020]).

Pending claim 14 requires the security paper as discussed above with respect to claim 1 and further requires a further lacquer layer comprising water-based dispersion lacquer disposed between the second upper and first lower lacquer layers (paragraph [0020]).

Pending claim 15 requires the security paper as discussed above with respect to claim 1 and further requires the lacquer layers of the protective layer to be conditioned with each other in their adhesion properties so as to form a highly resistant bond (paragraph [0021]).

Pending claim 17 requires the security paper as discussed above with respect to claim 1 and further requires either or both the second upper and first lower lacquer layer to be transparent and colorless (paragraph [0022]).

Pending claim 18 requires the security paper as discussed above with respect to claim 1 and further requires the second upper lacquer layer to have antibacterial fungus proofing (paragraph [0023]).

Pending claim 19 requires the security paper as discussed above with respect to claim 1 and further includes the first lower lacquer layer being present on the substrate in a coating weight of from 1 to 6 g/m^2 (paragraphs [0024], [0038], [0041], [0050]).

Pending claim 20 requires the security paper as discussed above with respect to claim 1 and further includes the first upper lacquer layer is present on the substrate in a coating weight of from 0.5 to 3 g/m^2 (paragraphs [0024], [0039], [0041], [0050]).

Pending claim 21 requires the security paper as discussed above with respect to claim 1 and further requires one or more of the substrate, first lower lacquer layer and second upper lacquer layer are printed with characters or patterns, and wherein in the case where the substrate is printed, the protective layer comprising said first lower

and said second upper lacquer layer is applied directly to said printed substrate, and in the case where the first lower lacquer layer is printed, the second upper lacquer layer is applied directly to said printed first lower lacquer layer (20, 22, Figures 3 and 4; paragraphs [0025], [0030], [0031], [0051]).

Pending claim 22 requires the security paper as discussed above with respect to claim 1 and the protective layer further contains at least one gap (paragraph [0025]).

Pending claim 23 requires the security paper as discussed above with respect to claim 22 and further requires the gap to have a security element incorporated therein (paragraph [0025]).

Pending claim 24 requires the security paper as discussed above with respect to claim 1 and further requires the protective layer to be applied to the entirety of the flat substrate (paragraph [0026]).

Pending claim 25 requires the security paper as discussed above with respect to claim 1 and further the flat substrate is provided with the dirt-repellent protective layer on its two main faces (paragraph [0026]).

Pending claim 26 recites a value document, exemplified by a bank note, passport or identification document (paragraphs [0001], [0002], [0027]), comprising security paper according to claim 1.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Whether claims 1, 3, 4, 11, 13-15, 17, 21, 24, and 26 are rendered obvious under 35 U.S.C. § 103(a) by the proposed combination of U.S. patent no. 5,820,971 (*Kaule et al.*) and U.S. patent no. 6,710,120 (*Gertzmann et al.*).

Whether claim 2 is rendered obvious under 35 U.S.C. § 103(a) by the proposed combination of U.S. patent no. 5,820,971 (*Kaule et al.*), U.S. patent no. 6,710,120 (*Gertzmann et al.*), and in further combination with U.S. patent no. 5,928,471 (*Howland et al.*).

Whether claims 12, 19, and 20 are rendered obvious under 35 U.S.C. § 103(a) by the proposed combination of U.S. patent no. 5,820,971 (*Kaule et al.*), U.S. patent no. 6,710,120 (*Gertzmann et al.*), and in further combination with U.S. patent no. 6,715,750 (*Gerlier et al.*).

Whether claim 18 is rendered obvious under 35 U.S.C. § 103(a) by the proposed combination of U.S. patent no. 5,820,971 (*Kaule et al.*), U.S. patent no. 6,710,120 (*Gertzmann et al.*), and in further combination with U.S. patent no. 6,905,711 (*Tullo et al.*).

Whether claim 25 is rendered obvious under 35 U.S.C. § 103(a) by the proposed combination of U.S. patent no. 5,820,971 (*Kaule et al.*), U.S. patent no. 6,710,120 (*Gertzmann et al.*), and in further combination with U.S. patent no. 4,462,866 (*Tooth et al.*).

Whether claims 22 and 23 are rendered obvious under 35 U.S.C. § 103(a) by the proposed combination of U.S. patent no. 5,820,971 (*Kaule et al.*), U.S. patent no. 6,710,120 (*Gertzmann et al.*), U.S. patent no. 6,059,914 (*Suss*), and in further combination with U.S. patent no. 4,462,866 (*Tooth et al.*).

VII. ARGUMENT

As discussed in detail below, the basis for the final rejection of claims 1-4, 11-15, and 17-26 does not satisfy the requirements of *prima facie* obviousness of the subject matter recited in the rejected claims. Therefore, reversal of the rejection of claims 1-4, 11-15, and 17-26 is respectfully requested.

A. Claim Rejections

Claims 1, 3, 4, 11, 13-15, 17, 21, 24, and 26 in this application are rejected under 35 U.S.C. § 103(a) as being unpatentable over the proposed combination of U.S. patent no. 5,820,971 (*Kaule et al.*) and U.S. patent no. 6,710,120 (*Gertzmann et al.*).

Claim 2 in this application is rejected under 35 U.S.C. § 103(a) as being unpatentable over the proposed combination of U.S. patent no. 5,820,971 (*Kaule et al.*), U.S. patent no. 6,710,120 (*Gertzmann et al.*), and in further combination with U.S. patent no. 5,928,471 (*Howland et al.*).

Claims 12, 19, and 20 in this application are rejected under 35 U.S.C. § 103(a) as being unpatentable over the proposed combination of U.S. patent no. 5,820,971 (*Kaule et al.*), U.S. patent no. 6,710,120 (*Gertzmann et al.*), and in further combination with U.S. patent no. 6,715,750 (*Gerlier et al.*).

Claim 18 in this application is rejected under 35 U.S.C. § 103(a) as being unpatentable over the proposed combination of U.S. patent no. 5,820,971 (*Kaule et al.*), U.S. patent no. 6,710,120 (*Gertzmann et al.*), and in further combination with U.S. patent no. 6,905,711 (*Tullo et al.*).

Claim 25 in this application is rejected under 35 U.S.C. § 103(a) as being unpatentable over the proposed combination of U.S. patent no. 5,820,971 (*Kaule et al.*), U.S. patent no. 6,710,120 (*Gertzmann et al.*), and in further combination with U.S. patent no. 4,462,866 (*Tooth et al.*).

Claims 22 and 23 in this application are rejected under 35 U.S.C. § 103(a) as being unpatentable over the proposed combination of U.S. patent no. 5,820,971

(*Kaule et al.*), U.S. patent no. 6,710,120 (*Gertzmann et al.*), U.S. patent no. 6,059,914 (*Suss*), and in further combination with U.S. patent no. 4,462,866 (*Tooth et al.*).

B. Pertinent Law

In rejecting claims under 35 U.S.C. § 103(a), it is incumbent upon the examiner to establish a factual basis to support the legal conclusion of obviousness. See *In re Fine*, 837 F.2d 1071, 1073, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). In so doing, the examiner is expected to make the factual determinations set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 17, 148 USPQ 459, 467 (1966).

The showings by the examiner are an essential part of complying with the burden of presenting a *prima facie* case of obviousness. See *In re Oetiker*, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992). For ease of review, the analysis used to make findings should be made explicit. See *KSR Intern. Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1741, 82 U.S.P.Q.2d 1385, 1396 (2007) citing *In re Kahn*, 441, F.3d 977, 988, 78 USPQ2d 1329 (Fed. Cir. 2006) "[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness".

If that burden is met, the burden then shifts to the applicant to overcome the *prima facie* case with argument and/or evidence. Obviousness is then determined on the basis of the evidence as a whole. See id.; In re Hedges, 783 F.2d 1038, 1039, 228 USPQ 685, 686 (Fed. Cir. 1986).

To establish *prima facie* obviousness of a claimed invention, all of the claim limitations must be taught or suggested by the prior art. See *In re Royka,* 490 F.2d 981, 180 USPQ 580 (CCPA 1974). It follows that all of the words recited in a claim must be considered in judging the patentability of that claim against the prior art. *In re Wilson*, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970). In particular, the question of whether the claimed invention as a whole would have been obvious, and not just whether the differences would have been obvious, must be addressed.

Stratoflex, Inc. v. Aeroquip Corp., 713 F.2d 1530, 218 USPQ 871 (Fed. Cir. 1983); *Schenck v. Nortron Corp.*, 713 F.2d 782, 218 USPQ 698 (Fed. Cir. 1983).

The meanings of the claim terms of the pending claims are to be "given their broadest reasonable interpretation consistent with the specification." See *Phillips v. AWH Corp.*, 415 F.3d 1303, 75 USPQ2d 1321 (Fed. Cir. 2005).

Specifically, as outlined in detail in MPEP § 2111:

> During patent examination, the pending claims must be "given their broadest reasonable interpretation consistent with the specification." >The Federal Circuit's *en banc* decision in *Phillips v. AWH Corp.*, 415 F.3d 1303, 75 USPQ2d 1321 (Fed. Cir. 2005) expressly recognized that the USPTO employs the "broadest reasonable interpretation" standard:
>
> > The Patent and Trademark Office ("PTO") determines the scope of claims in patent applications not solely on the basis of the claim language, but upon giving claims their broadest reasonable construction "in light of the specification as it would be interpreted by one of ordinary skill in the art." *In re Am. Acad. of Sci. Tech. Ctr.*, 367 F.3d 1359, 1364[, 70 USPQ2d 1827] (Fed. Cir. 2004). Indeed, the rules of the PTO require that application claims must "conform to the invention as set forth in the remainder of the specification and the terms and phrases used in the claims must find clear support or antecedent basis in the description so that the meaning of the terms in the claims may be ascertainable by reference to the description." 37 CFR 1.75(d)(1).
>
> 415 F.3d at 1316, 75 USPQ2d at 1329. See also< *In re Hyatt*, 211 F.3d 1367, 1372, 54 USPQ2d 1664, 1667 (Fed. Cir. 2000). Applicant always has the opportunity to amend the claims during prosecution, and broad interpretation by the examiner reduces the possibility that the claim, once issued, will be interpreted more broadly than is justified. *In re Prater*, 415 F.2d 1393, 1404-05, 162 USPQ 541, 550-51 (CCPA 1969) (Claim 9 was directed to a process of analyzing data generated by mass spectrographic analysis of a gas. The process comprised selecting the data to be analyzed by subjecting the data to a mathematical manipulation. The examiner made rejections under 35 U.S.C. 101 and 102. In the 35 U.S.C. 102 rejection, the examiner explained that the claim was anticipated by a mental process augmented by pencil and paper markings. The court agreed that the claim was not limited to using a machine to carry out the process since the claim did not explicitly set forth the machine. The court explained that "reading a claim in light of the specification, to thereby

> interpret limitations explicitly recited in the claim, is a quite different thing from 'reading limitations of the specification into a claim,' to thereby narrow the scope of the claim by implicitly adding disclosed limitations which have no express basis in the claim." The court found that applicant was advocating the latter, i.e., the impermissible importation of subject matter from the specification into the claim.). See also *In re Morris,* 127 F.3d 1048, 1054-55, 44 USPQ2d 1023, 1027-28 (Fed. Cir. 1997) (The court held that the PTO is not required, in the course of prosecution, to interpret claims in applications in the same manner as a court would interpret claims in an infringement suit. Rather, the "PTO applies to verbiage of the proposed claims the broadest reasonable meaning of the words in their ordinary usage as they would be understood by one of ordinary skill in the art, taking into account whatever enlightenment by way of definitions or otherwise that may be afforded by the written description contained in applicant's specification.").
>
> The broadest reasonable interpretation of the claims must also be consistent with the interpretation that those skilled in the art would reach. *In re Cortright*, 165 F.3d 1353, 1359, 49 USPQ2d 1464, 1468 (Fed. Cir. 1999) (The Board's construction of the claim limitation "restore hair growth" as requiring the hair to be returned to its original state was held to be an incorrect interpretation of the limitation. The court held that, consistent with applicant's disclosure and the disclosure of three patents from analogous arts using the same phrase to require only some increase in hair growth, one of ordinary skill would construe "restore hair growth" to mean that the claimed method increases the amount of hair grown on the scalp, but does not necessarily produce a full head of hair.).

Therefore, as can be seen from the above excerpt, the Office must interpret the claims broadly, but also must interpret the claims reasonably consistent with the specification and reasonably consistent with the interpretation that those skilled in the art would reach.

This methodology "does not give the PTO an unfettered license to interpret claims to embrace anything remotely related to the claimed invention. Rather, claims should always be read in light of the specification and teachings in the underlying patent." (*In Re Suitco Surface*, 603 F.3d 1255, 1260, 94 U.S.P.Q2d 1640 (Fed. Cir. 2010), referencing *Schriber-Schroth Co. v. Cleveland Trust Co.*, 311 U.S. 211, 216, 61 S.Ct. 325 (1940)).

C. Proper interpretation of "physically drying" as recited in independent claim 1

It is respectfully submitted for the reasons discussed in detail below that the "physically drying" lower lacquer layer as recited in claim 1 must be interpreted as a lacquer layer that only dries by physical mechanisms, and not a *hybrid* lacquer layer, which may dry by both physical mechanisms and by chemical (curing; polymerization) mechanisms, in contrast to the interpretation taken by the Office in the Office action dated September 27, 2010, and the Advisory Action dated January 6, 2011, in which it is asserted that a "physically drying" lower lacquer layer can include both elements of a physically drying and a chemically drying lacquer layer (also referred to as a "hybrid" lacquer in the specification).

A review of the specification as originally filed indicates that applicants recognized a problem that the use of radiation-curing lacquers, in particular UV-drying lacquers, have a disadvantage in that residual monomers and free photoinitiators remain as very reactive components in the depressions and pores of a substrate after radiation curing, in dependence on a number of factors (specification paragraph [0011]). Applicants note that this problem occurs increasingly when the UV lacquer layer penetrates into a paper fiber composite of, for example, a security paper (specification paragraph [0012]).

As discussed in detail, the applicants indicate that the positive properties of UV lacquering can be fully exploited if a combination coating is used that includes a lower lacquer layer that makes contact with the substrate and closes its pores, and the upper lacquer layer is applied to protect the substrate from physical and chemical influences (specification paragraph [0012]).

The substrates typically used for security papers include un-printed or printed cotton paper, which has high porosity and surface roughness with microscopic projections and cavities where residual monomers and photoinitiators of a radiation-curing lacquer layer would be deposited in the absence of the inventive lower lacquer layer (specification paragraph [0013]).

Thus, as can be seen from the specification as originally filed, one purpose of the inventive lower layer is to prevent residual monomers and photoinitiators of a radiation-curing lacquer layer from being deposited into microscopic projections and cavities of a substrate.

A person having ordinary skill in the art would recognize from a reading of the specification that if the inventive lower lacquer layer included radiation-curing components, such as monomers and photoinitiators, then the purpose of the inventive lower lacquer layer to prevent residual radiation-curing components, such as monomers and photoinitiators, from being deposited into microscopic projections and cavities of a substrate would not be achieved.

Thus, a lower lacquer layer having radiation-curing components, such as monomers and photoinitiators, is in direct contrast with a reasonable reading of the specification as originally filed, and as would be understood by a person having ordinary skill in the art.

As written, claim 1 recites a first lower lacquer layer "being formed by a physically drying liquid lacquer layer."

Throughout the prosecution history, applicants have maintained the position, consistent with the specification as originally filed, that a "physically drying" lacquer layer does not include any radiation-curing or other chemically-curing components.

As discussed in detail in the response filed December 27, 2010 (pages 17-19), which comments are herein incorporated by reference in their entirety, applicants (and persons having ordinary skill in the art, as evidenced by the excerpt (in particular Fig. 1.7-1, page 167) from "Handbook of Print Media" (copy attached in **X. Evidence Appendix**)) recognize three distinct drying effects, which can be implemented in the disclosed and recited lacquers.

First, a *physically drying lacquer* (whereupon during drying, the water component is physically removed), second, *chemical or radiation-curing lacquers* (curing by irradiation, and having the above-noted disadvantages when used as a

lower lacquer layer), and third, *hybrid lacquers* (containing both physically drying components and chemical or radiation-curing components). The three categories stem from the delineation between physical drying (solidification, evaporation, and penetration) and chemical drying (which requires polymerization/cross-linking), and which recognizes a "hybrid" category of both physical and chemical drying.

As noted above, pending claim 1 recites a first lower lacquer layer "being formed by a physically drying liquid lacquer layer."

Additionally, claim 1 recites that the second upper lacquer layer is formed as any one of a) a radiation-curing lacquer layer, b) a physically drying lacquer layer, and c) a hybrid lacquer layer containing both physically drying components and a radiation-curing component.

Thus, claim 1 itself recognizes a distinction between "physically drying" lacquer layers, and lacquer layers that include both physically drying components and a radiation-curing component, in other words "hybrid" lacquer layers.

In order to reconcile this distinction within claim 1 itself, and in view of the specification as originally filed, and further in view of the understanding of a person having ordinary skill in the art, the "physically drying" lower lacquer layer as recited in claim 1 must be interpreted as a lacquer layer that only dries by physical mechanisms, and not a *hybrid* lacquer layer, which may dry by both physical mechanisms and by chemical (curing; polymerization) mechanisms.

D. <u>In view of the proper interpretation of claim 1, the proposed combination of the *Kaule* and *Gertzmann* patents does not amount to a *prima facie* case of obviousness with respect to claim 1</u>

The discussion below is focused on the apparatus of independent claim 1. The dependent claims 2-4, 11-15, and 17-26 stand or fall with independent claim 1.

Reversal of the rejection of claim 1 is respectfully requested on the basis that the *Kaule* and *Gertzmann* patents, whether considered individually or collectively, fail

to disclose or suggest every feature of the security paper according to claim 1 as properly interpreted.

As will be discussed in detail below, the proposed combination of the *Kaule* and *Gertzmann* patents fails to disclose at least a physically drying first lower lacquer layer based on a water-based dispersion of aliphatic polyester polyurethanes or styrene-acrylic polyurethanes; and a second upper lacquer layer formed as any one of the following layers a), b), or c):

a) a radiation-curing UV-crosslinked lacquer layer;

b) a physically drying water-based dispersion lacquer layer based on styrene-acrylic without a polyurethane component;

c) a hybrid lacquer layer containing both physically drying components and a radiation-curing lacquer component, and based on aqueous dispersions on the basis of aliphatic urethane acrylates and acrylates with photoinitiators, all as required by pending claim 1.

Accordingly, claim 1 is patentable in view of the proposed combination of teachings of the *Kaule* and *Gertzmann* patents, since the proposed combination of these references does not constitute a case of *prima facie* obviousness with respect to pending claim 1.

The deficiencies of the proposed combination of the *Kaule* and *Gertzmann* patents is discussed in detail at least in the response filed December 27, 2010, which comments are incorporated by reference herein in their entirety.

As noted, the Office action dated September 27, 2010 and the Advisory Action dated January 6, 2011 reject claim 1 as being obvious in view of the proposed combination of the *Kaule* and *Gertzmann* patents.

As acknowledged on pages 3 and 8 of the Office action dated September 27, 2010, the *Kaule* patent discloses the use of UV-curable (radiation curable) and chemically curing coating compositions.

In particular, and as discussed in detail in previously submitted responses (page 19, response filed June 19, 2009; pages 12-13, response filed March 2, 2010; page 16, response filed July 19, 2010; page 14, response filed December 27, 2010), the terms "reaction lacquer" and "reaction adhesive" are *defined* in the *Kaule* patent as lacquers or adhesives that cure, i.e. polymerize or cross-link, irreversibly under specific physical (i.e. radiation) or chemical activation (col. 3, lines 53-58).

As previously pointed out during the prosecution of pending claim 1, and as acknowledged on pages 2 and 3 of the Office action dated September 27, 2010, the *Kaule* patent specifically discloses that the lower reaction layer (4) and the upper reaction layer (2) are largely homogenous chemically, in order to provide a very firm compound in areas where the metal layer contains pores or microcracks.

While the Office action dated September 27, 2010 notes on page 3 that such a requirement does not require the layers to be cured in the same way, it is respectfully reiterated that as previously pointed out, the *Kaule* patent only discloses the use of *curing* compositions, in which lacquers or adhesives that cure, i.e. polymerize or cross-link, irreversibly under specific physical (i.e. radiation) or chemical activation are provided (col. 3, lines 53-58), and does not disclose or suggest the use of a physically drying liquid lacquer layer for the lower layer in the *Kaule* patent, as is required by pending claim 1.

Further, while the Office action dated September 27, 2010 indicates on page 3 that a person having "ordinary skill in the art would have found it obvious to use a chemically curing adhesive layer and a chemically curing or UV-curing embossed layer that is largely homogenous with the adhesive layer as an embodiment within the Specification of Kaule et al [*sic*] and have a reasonable expectation of success," even if this assertion is true, the *Kaule* patent still fails to disclose the use of a physically drying liquid lacquer layer for the lower layer in the *Kaule* patent, as is required by pending claim 1.

In particular, if a chemically curing adhesive layer is used for the lower adhesive layer (4) of the *Kaule* patent, since pending claim 1 recites a "physically

drying" lacquer layer, such a chemically curing adhesive layer does not render claim 1 *prima facie* obvious.

Additionally, since a physically drying liquid lacquer layer of the type recited in pending claim 1 will not cure (i.e. will not polymerize or cross-link), such a physically drying liquid lacquer layer will not be "largely homogenous chemically" to a lacquer or adhesive that cures, i.e. polymerizes or cross-links, irreversibly under specific physical (i.e. radiation) or chemical activation, as is required of the two layers of the *Kaule* patent. In particular, "curing" alters the chemical composition of the lacquer or adhesive by cross-linking the polymer chains. In contrast, in a lacquer that is only "physically" dried, there is no curing, and thus, no cross-linking of the polymer chains.

The Office action dated September 27, 2010 turns to the *Gertzmann* patent in an attempt to cure the deficiencies of the *Kaule* patent. However, on pages 8 and 9, the Office action dated September 27, 2010 acknowledges that the *Gertzmann* patent discloses compositions containing "crosslinkers."

While the *Gertzmann* patent may disclose "hybrid" aqueous dispersions, similarly to the *Kaule* patent, all of the compositions of the *Gertzmann* patent are curable, i.e. polymerizes or cross-links, irreversibly under specific physical (i.e. radiation) or chemical activation.

The Office action dated September 27, 2010 on page 9 asserts that "The applied coating compositions" of the *Gertzmann* patent "form films that are dried (reads on physically drying) and may be (but are not required to be) further irradiated with UV light" where photoinitiators are included.

The Advisory Action dated January 6, 2011, on page 3, further suggests that the *Gertzmann* patent "discloses compositions that are physically dried and may be (but are not required to be) further irradiated with UV light (presumably cured) (col 11, lines 31-42)." This assertion was addressed in detail on page 16 in the response filed December 27, 2010.

Specifically, while admittedly, not all of the compositions disclosed in the *Gertzmann* patent include photoinitiators, it is respectfully submitted that all of the compositions disclosed in the *Gertzmann* patent include some form of curing, i.e. polymerization or cross-linking, irreversibly under specific physical (i.e. radiation) or chemical activation. While the passage relied upon by the Advisory Action dated January 6, 2011 does teach that the coating film may be dried at room temperature (or an elevated temperature), the coating composition is a polyurethane dispersion, which undergoes a oxidative crosslinking (chemical reaction) in order to cure, which chemical reaction may be accelerated by the use of siccatives and/or photoinitiators (see *Gertzmann* patent, col. 11, lines 9-17).

As is shown by the discussion at least in Fig. 1.7-1 of the "Handbook of Print Media," such oxidative crosslinking is clearly a chemical drying process, and not a physical drying process, as is required of the lower lacquer layer in pending claim 1.

Thus, even if the compositions disclosed in the *Gertzmann* patent are substituted for the compositions of the *Kaule* patent, the proposed combination of the *Kaule* and *Gertzmann* patents still fails to disclose a "physically drying" lower lacquer layer as recited in pending claim 1.

Additionally, it appears that the Office action dated September 27, 2010 and the Advisory Action dated January 6, 2011 are taking the position that a hybrid composition that includes some physical drying, which is followed by some form of curing, i.e. polymerization or cross-linking, irreversibly under specific physical (i.e. radiation) or chemical activation, reads on a "physically drying" lacquer layer as recited in pending claim 1.

As discussed in section VII. C. above, this interpretation is inconsistent with the specification as originally filed, and is also inconsistent with the understanding of a person having ordinary skill in the art.

As discussed above, and in the response filed December 27, 2010, using any type of curing lacquer layer or hybrid lacquer layer as the lower lacquer layer recited in claim 1 would defeat the purpose of the disclosed embodiments of using the

physically drying lacquer layer as the lower layer in order to prevent migration of uncured reactive components into the pores of the substrate. Thus, the position in the Office action dated September 27, 2010 and the Advisory Action dated January 6, 2011 that a *hybrid* layer that has physically drying components and curing or cross-linking components, can be considered to be a physically drying lacquer layer is completely contrary to and inconsistent with the structure and function of the physically drying lower lacquer layer recited in pending claim 1, and is therefore an untenable position.

Therefore, as previously noted, even if a person having ordinary skill in the art were to look to the *Gertzmann* patent to substitute coating compositions for the layers of the *Kaule* patent, since the *Gertzmann* patent only discloses chemically curing and/or hybrid compositions, the proposed combination of the *Kaule* and *Gertzmann* patents still fails to disclose a lower lacquer layer that is a physically drying lacquer layer, as is required by pending claim 1.

Accordingly, for at least these reasons, it is respectfully submitted that the proposed combination of the *Kaule* and *Gertzmann* patents fails to establish a *prima facie* case of obviousness with respect to pending claim 1, and reversal of this rejection is respectfully requested.

The remaining pending claims 2-4, 11-15, and 17-26, which depend from claim 1, contain all of the elements of claim 1, as well as their respective recited features. As noted above, the dependent claims 2-4, 11-15, and 17-26 stand or fall with independent claim 1. Accordingly, since the proposed combination of the *Kaule* and *Gertzmann* patents fails to establish a *prima facie* case of obviousness with respect to claim 1, and since dependent claims 2-4, 11-15, and 17-26 stand or fall with independent claim 1, the proposed combination of the *Kaule* and *Gertzmann* patents, alone or in combination with the various other cited prior art patents to *Howland*, *Gerlier*, *Tullo*, *Tooth*, and *Suss* patents, fails to establish a *prima facie* case of obviousness with respect to claims 2-4, 11-15, and 17-26, and reversal of these rejections is respectfully requested.

VIII. Conclusion

For the reasons set forth above, claims 1-4, 11-15, and 17-26 of the pending application define subject matter that is not rendered *prima facie* obvious within the meaning of 35 U.S.C. § 103(a) by the proposed combination of the *Kaule* and *Gertzmann* patents alone or in combination with the various other cited prior art patents to *Howland*, *Gerlier*, *Tullo*, *Tooth*, and *Suss* patents.

Therefore, reversal of the rejection of claims 1-4, 11-15, and 17-26 is respectfully requested.

The Fee required by 37 C.F.R. § 1.17(b) and 41.20(b)(2) is submitted herewith. The Office is authorized to charge any additional fees associated with this communication to Deposit Account No. 02-0200.

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IX. CLAIMS APPENDIX

1. A security paper for producing value documents, exemplified by bank notes, passports or identification documents, comprising a flat substrate provided at least partly with a dirt-repellent protective layer for extending the life time and fitness for circulation, wherein

the protective layer comprises at least two lacquer layers, a first lower one of said lacquer layers being formed by a physically drying liquid lacquer layer applied to the substrate which makes contact with the substrate therebelow and closes its pores, and a second upper one of said lacquer layers protecting the substrate from physical and chemical influences;

wherein the first lower lacquer layer is based on a water-based dispersion of aliphatic polyester polyurethanes or styrene-acrylic polyurethanes; and

the second upper layer is formed as any one of the following layers a), b), or c):

a) a radiation-curing UV-crosslinked lacquer layer;

b) a physically drying water-based dispersion lacquer layer based on styrene-acrylic without a polyurethane component;

c) a hybrid lacquer layer containing both physically drying components and a radiation-curing lacquer component, and based on aqueous dispersions on the basis of aliphatic urethane acrylates and acrylates with photoinitiators.

2. The security paper according to claim 1, wherein the substrate is formed by an unprinted or printed cotton paper.

3. The security paper according to claim 1, wherein the lower lacquer layer forms a smooth and contiguous layer on the substrate.

4. The security paper according to claim 1, wherein the first lower lacquer layer is elastic so as to at least avoid cracks from forming therein through mechanical motions.

5-9. (Canceled)

10. The security paper according to claim 1, wherein the second upper lacquer layer further comprises silicones and/or wax.

11. The security paper according to claim 1, wherein the UV-crosslinked lacquer layer is based on an acrylate system.

12. The security paper according to claim 1, wherein the composition of the upper lacquer layer is selected with respect to brittleness and surface tension so as to

obtain a predetermined haptics of the security paper, in particular a predetermined smoothness, and/or flexural stiffness.

13. The security paper according to claim 1, wherein the second upper lacquer layer is disposed directly on the first lower lacquer layer.

14. The security paper according to claim 1, wherein a further lacquer layer comprising water-based dispersion lacquer is disposed between the second upper and first lower lacquer layers.

15. The security paper according to claim 1, wherein the lacquer layers of the protective layer are conditioned with each other in their adhesion properties so as to form a highly resistant bond.

16. (Canceled)

17. The security paper according to claim 1, wherein either or both the second upper and first lower lacquer layer is transparent and colorless.

18. The security paper according to claim 1, wherein the second upper lacquer layer has antibacterial fungus proofing.

19. The security paper according to claim 1, wherein the first lower lacquer layer is present on the substrate in a coating weight of from 1 to 6 g/m^2.

20. The security paper according to claim 1, wherein the first upper lacquer layer is present on the substrate in a coating weight of from 0.5 to 3 g/m^2.

21. The security paper according to claim 1, wherein one or more of the substrate, first lower lacquer layer and second upper lacquer layer are printed with characters or patterns, and wherein in the case where the substrate is printed, the protective layer comprising said first lower and said second upper lacquer layer is applied directly to said printed substrate, and in the case where the first lower lacquer layer is printed, the second upper lacquer layer is applied directly to said printed first lower lacquer layer.

22. The security paper according to claim 1, wherein the protective layer contains at least one gap.

23. The security paper according to claim 22, wherein the gap has a security element incorporated therein.

24. The security paper according to claim 1, wherein the protective layer is applied to the entirety of the flat substrate.

25. The security paper according to claim 1, wherein the flat substrate is provided with the dirt-repellent protective layer on its two main faces.

26. A value document, exemplified by a bank note, passport or identification document, comprising security paper according to claim 1.

X. EVIDENCE APPENDIX

HEIDELBERG

Helmut Kipphan (Ed.)

Handbook of Print Media

Technologies and Production Methods

Including 1275 figures, mostly in color
and 92 tables

Springer

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1.7 Drying Methods

The term "drying" includes all processes taking place after the ink transfer, for instance, from the blanket or printing plate onto the substrate, thereby providing a stable linkage between the substrate and the printing ink. The printing ink solidifies during the course of this process, creating a prerequisite for reliable print finishing and later use of the printed products.

Depending on the ink build-up, drying is effected either by chemical reaction (oxidation or polimerization) or by physical processes (penetration, evaporation) or by a combination of both. Figure 1.7-1 shows an overview of the drying methods and their primary fields of application.

Figure 1.7-2 shows a sheet-fed offset press with several drying systems integrated into the delivery. Different drying methods for inks and varnishes often require different systems – also in the form of combined systems – for an optimum drying process. It can be useful to install both an IR and a UV dryer to ensure a variable capability of the printing press (see also figs. 2.1-58 and 2.1-60).

The structure of the printing inks has to meet two opposing requirements with regard to the drying properties:

- no drying on the rollers during press operation or short standstill periods,
- fast drying and anchoring on the substrate after printing.

The following factors are the most crucial ones for the drying properties of the printing inks:

- the ink's composition, above all with regard to the vehicle used, the carrier and relevant additives,
- characteristic features of the material to be printed (penetration capacity, etc.),
- printing conditions (ink quantity transferred, pile height, printing speed),
- climatic conditions (humidity, room temperature),
- dryer construction (air stream on the ink surface, reaction period, type of energy supply, etc.).

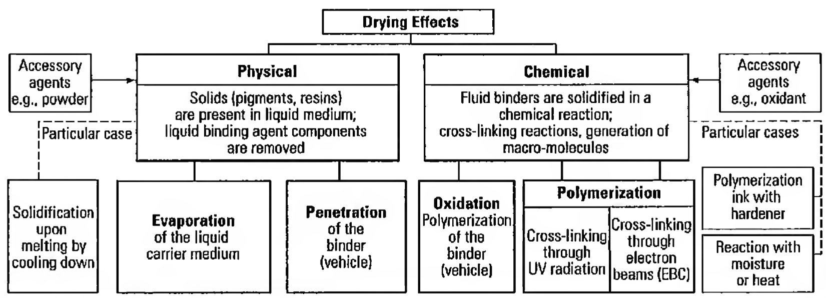
The temperature is a decisive factor – in general, higher temperatures are beneficial:

- the polymerization speed is accelerated,
- the ink viscosity is reduced to support penetration,
- there is faster evaporation of the solvents.

The degree of bonding between the inks and the substrate varies after the drying process is finished. As for the possible stress of the prints, there is a classification by the following characteristics: abrasion resistance, scratch proofing, scratch resistance, pile resistance, and wiping stability against wiping (see also sec. 1.7.4).

1.7.1 Physical Drying (Absorption)

Penetration is achieved by the interaction of printing ink and substrate (see also sec. 1.5.2). It depends above all on the carrier viscosity of the printing ink, the vehicle (binder) and the absorption capacity of the substrate.



a

Drying methods	Drying Effects: Evaporation	Penetration	Oxidation	Polymerization	Solidification	Two-component polymerization	Use (mainly)
Hot-air drying	X	x	(x)			x (Polymerization is accelerated)	Web offset (heatset) Gravure printing Flexo printing Screen printing Ink jet Dispersion varnish (water-based)
IR drying		X	(x)			x (Polymerization is accelerated)	Sheet offset
UV drying		(x)		X			Flexo printing Sheet offset Screen printing Varnishes
Excimer				X			Flexo printing
EBC				X			Web offset
Cooling (Hot-melt inks)					X		Ink jet

b

Symbols: **X** main effect; x, (x) further effects of less importance

Fig. 1.7-1 Drying processes.
a Overview of drying types and effects;
b Overview of drying methods, drying effects and fields of application

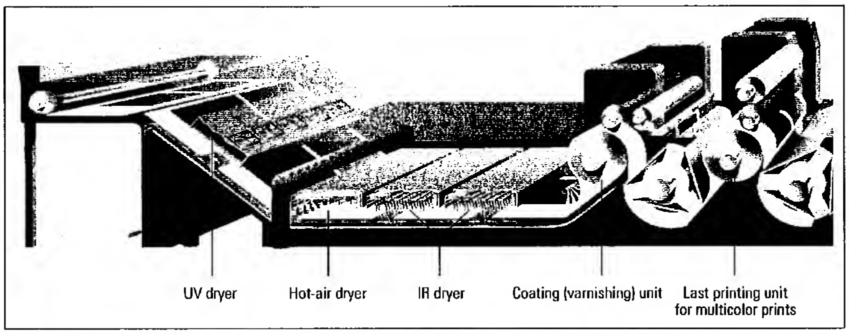


Fig. 1.7-2 Installation of different types of drying systems in a sheet offset press (Speedmaster CD, Heidelberg)

The printing ink components start *penetrating* with the transfer of the printing ink onto the paper and are sucked up into the paper by paper capillary tubes.

Consequently, penetration in the substrate depends on the *absorbency* and the *absorbing speed* of the substrate. The absorbing speed is determined by the porosity and the wetting quality. Porosity is characterized by the number of pores per area and the average pore diameter. Moreover, the absorbing speed is greater, the lower the viscosity of the printing ink.

Figure 1.7-3 explains the dependency of the ink penetration behavior on the absorption capacity of the substrate. In a test, the optical density of the ink film transferred on the counter sheet is measured relative to the drying period. (A counter sheet is an unprinted sheet unrolled defined on the freshly printed image. The optical density of the image reproduced on the counter sheet is measured, providing a value for the degree of drying.) Figure 1.7-3 shows that the non-absorbing substrate 1 still displays a very high counter print density after 120 minutes – it has not yet fully dried. Penetration is improved by smaller substrate pore sizes.

Too high an absorption capacity of the substrate can cause the printing ink to deplete vehicles. The ink loses brilliance and abrasion resistance and pigments can be wiped off. That is why papers with a good separation effect, that is, papers with a high *density of small pores*, are usually the optimum substrate for fine print results and for drying (e. g., art paper).

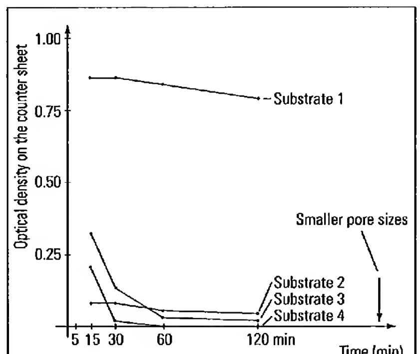


Fig. 1.7-3
Penetration behavior of ink (counter-print density) relative to substrate and time

Penetration depends on the absorption capacity of the substrate, but also on the viscosity (fig. 1.7-4) of the printing ink [1.7-1]. Absorbing speed also depends on the wetting behavior between the printing ink and the substrate.

In newspaper printing, *drying is effected by mere penetration* (coldset). The penetration process is carried out in a split second and the drying process is finished. Usually, printing inks used in newspaper printing do not contain drying oils (mineral oils). In cases where printing inks are used whose vehicles consist of drying oils, chemical drying by oxidation is triggered after penetration (see sec. 1.7.2).

1.7.1.1 Infrared (IR) Drying

Penetration of a printing ink is faster if the viscosity is low. Viscosity decreases when the temperature is raised. The transferred ink film can be heated up together with the substrate by using an IR radiation source (fig. 1.7-2). The IR drying effect in offset printing can be described in the following way:

- Lowering of the ink oils' *viscosity* by heating results in faster penetration.
- *Oxidation* in the warm pile is faster.

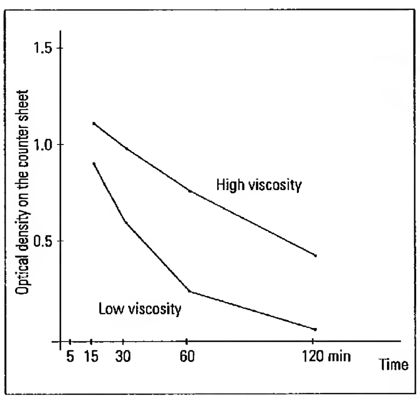


Fig. 1.7-4
Penetration behavior of ink (counter-print density; see also fig. 1.7-16) relative to ink viscosity and time

- Oxidation is accelerated by smaller *proportions of water* in the ink layer applied.

The chemical drying process (oxidation) following the physical drying process is also accelerated by a rise in temperature (see sec. 1.7.2).

The above processes are detectable in almost any kind of offset ink. Harmonizing IR radiation ranges and vehicle components absorbing within these frequency ranges helps to improve the effect of the radiators. Optimum effect of an IR radiator is achieved if maximum energy of the radiator and maximum penetration of the printing ink (or the varnish) coincide.

Wave ranges of the IR spectrum within the electromagnetic radiation spectrum are shown in figure 1.7-5. Infrared radiators are used in the following ranges of wave length:

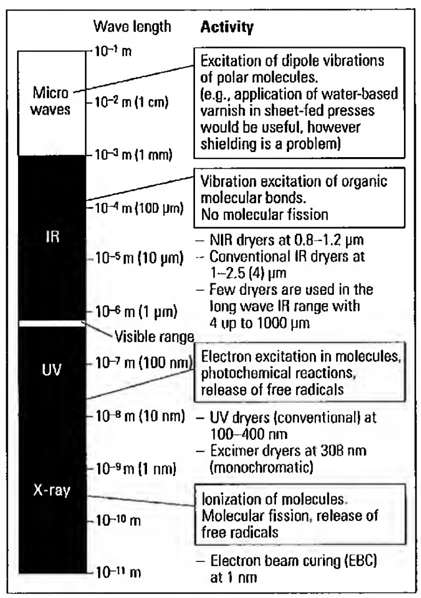


Fig. 1.7-5 Electromagnetic radiation spectrum for ink drying

- *short-wave* (0.8–2 μm, corresponding to a spiral-wound filament temperature of 2700–1500 °C), radiation penetrates mainly into the paper;
- *medium-wave* (2–4 μm, corresponding to 1500–750 °C), the air is heated mainly above the ink layer.

Experience has shown that optimum *absorption of ink* is achieved with short- or medium-wave IR radiators. Moreover, the short-wave radiator has a higher G-value (radiation efficiency). The so-called NIR dryers (near infrared, 0.8–1.2 μm) work in the lower short-wave range. Due to low efficiency, long-wave radiators (4 μm to 1 mm) are not suitable for offset drying.

As penetration is particularly important for fast drying, IR drying is most effective only if absorbent substrates are printed on. Figure 1.7-6 gives a description of the *IR radiation effect* on the penetration behavior.

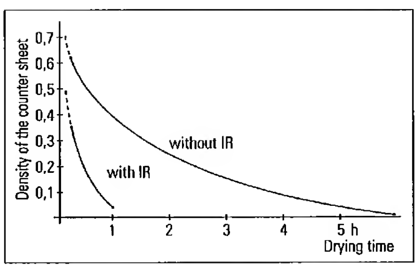


Fig. 1.7-6
Influence of IR radiation on penetration behavior (sheet-fed offset ink on coated paper)

The IR radiator heats unprinted areas in the paper, too, which results in an increase in the *pile temperature* (up to 40 °C) and an advantageous faster polymerization (see sec. 1.7.1). The pros and cons of IR drying are summarized in table 1.7-1.

1.7.1.2 Evaporative Drying

The printing ink consists of several components such as resins, pigments, and solvents, the drying of which is achieved partly by *evaporation*. The following processes take place:

- conversion from liquid (solvent) into vapor state and
- eduction of steam generated or steam-loaded air.

As a rule, only as much heat should be supplied as is dissipated in the generating steam, regardless of the type of heat supply and bearing in mind the economic efficiency and the careful treatment of the product to be dried. This rule is to be followed particularly when designing a dryer for printing presses since the substrate should be heated as little as possible for known difficulties such as register inaccuracy, variations of the visco-elastic properties of the substrate, and warping. The solvent evaporates when a printing ink is dried by evaporation. The drying process is determined by the *heat and material transport* in the boundary film on the surface of a liquid (printing ink).

The surface temperature, and above all the air speed along the substrate surface as well as the partial pressure difference are the main parameters for the *drying speed* [1.7-2, 1.7-3]. Drying by evaporation is accelerated by additionally enforced convection. Therefore, heating via heat radiators and/or hot air is to be com-

Table 1.7-1 Pros and cons of IR drying

Pros	Cons
Faster penetration of the printing ink resulting in more favorable pile behavior with respect to ink set-off	Higher investment leading to a higher hourly rate of the press due to the installation of the IR system
Considerably faster final drying	Higher energy consumption
Lower powder consumption for spraying the printed sheets before they are delivered in the pile, resulting in better print quality and less dirt accumulation in the press	Increased temperature in the machine as well as in the press room
Print finishing is made easier by less powder application	

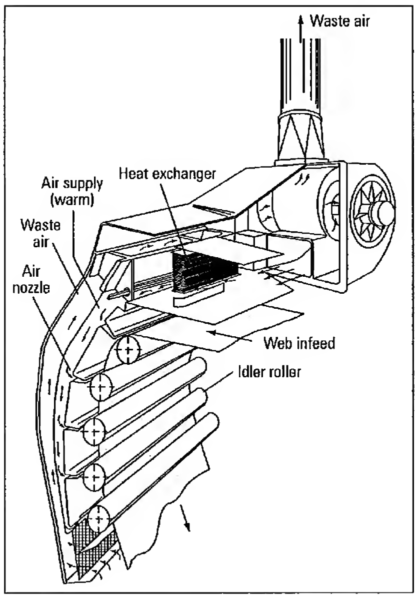


Fig. 1.7-7
Vertical blast dryer (with single-sided drying) in a web-fed gravure press

bined with optimum air conduction. Figure 1.7-7 shows a *vertical blast dryer* used for gravure printing.

This dryer is optimized with regard to aerodynamics. Such vertical blast dryers are used for drying printing inks containing low-boiling solvents mainly used in gravure and flexographic printing. The organic vapors generated are taken up via adsorption on activated carbon in solvent recuperative systems.

The supersorbon method (fig.1.7-8) for *solvent recuperation* [1.7-4] includes the following processes:

- *Charging (adsorbing).* Air containing solvent is extracted by a fan at the evaporation points (e.g., gravure printing press, vertical blast dryer) and conveyed from the bottom upwards by one or several adsorbers filled with activated carbon. The solvent is adsorbed by the activated carbon. Solvent-free air penetrates at the top (fig. 1.7-8). Charging of the adsorbers is continued until it "breaks through," that is, until the vapors are no longer sufficiently adsorbed.
- *Regenerating (desorbing).* Extracted activated carbon is regenerated in reverse exhaustion flow direction by way of desorption with water vapor. The activated carbon is heated to a little over 100°C; the solvents – including higher-boiling point solvents – are vapor-expelled. They condense in the water of the container and can now be separated from the water and become reusable.

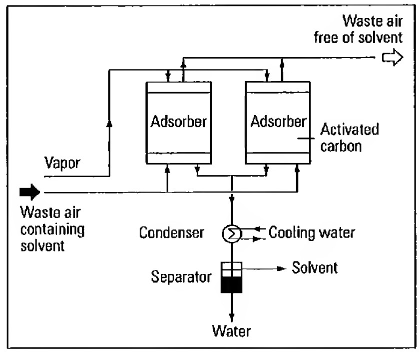


Fig. 1-7-8
Flow chart of the Supersorbon method (simplified representation) (Lurgi [1.7-4])

Heatset Dryer

Unlike gravure printing, printing inks used in *web offset* contain a high portion of high-boiling point mineral oils (heatset oils). Low-boiling point oils cannot be used as such printing inks become dry on the rollers while the ink is transferred in the roller-type inking unit. Heatset inks used in web offset contain between 20% and 40% high-boiling point mineral oils. Therefore, appropriately adapted evaporative dryers are to be used in web offset.

"Suspension dryers" (fig. 1.7-9) are mainly used as drying units in web offset (see also sec. 2.1.3). The web is routed contact-free through those dryers without guid-

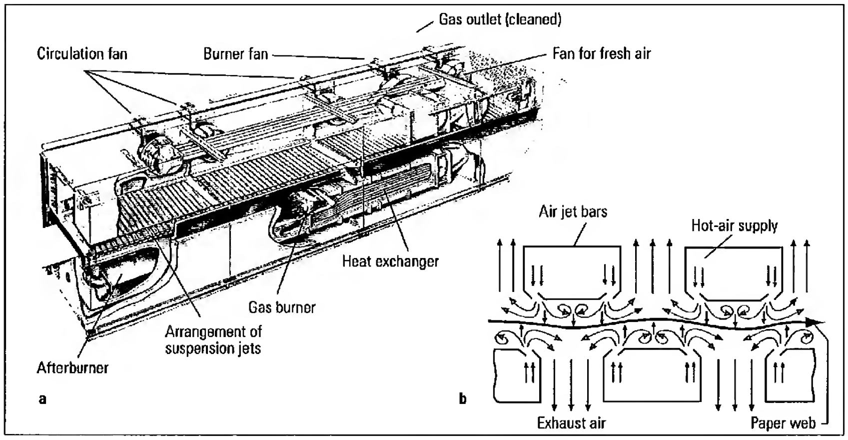


Fig. 1.7-9 Suspension dryer for web offset presses.
a Sectional drawing;
b Web guidance with suspension jets (Ecotherm, Heidelberg)

ing elements. This is achieved by a well-directed blower stream in the hot-air dryer. Floating dryers are roughly classified according to the type of air stream applied to the surface of the web of fabric. They all have in common that the web is conveyed at high speeds through the dryer without it contacting any surface. A web that is transported in such a way demands high standards regarding method, mechanics, and control engineering in order to achieve optimum and economic drying and a smooth production flow. The waste air is directed via an after-burner. The heat generated during combustion is used again to heat the dryer.

1.7.1.3 Problems in Practical Operation

In general, physical drying is influenced by various parameters. The following examples will illustrate this:

- Drying becomes more critical if the *penetration speed* decreases, or if the ink application increases in the image, or if the grammage of the substrate increases.
- *Blistering* may occur with high grammage, double-coated, and heavily calendered papers. Water vapor penetration capacity is reduced to a minimum due to the surface densification. High ink application might cause the temperatures to rise so high – particularly with short dryers – that the water vapor generating in the paper partly splits the paper, which in turn results in blisters and a large number of waste sheets. The temperature of the dryer and the print speed are then reduced.
- Drying is dependent on the speed at which the paper web passes through the dryer. The temperature of the dryer should be set according to the paper grammage: the higher the *grammage*, the higher the temperature. In order to achieve sufficient drying, the paper web needs to remain in the drying area for 0.8 to 1 second. If the paper web is conducted at a speed of 8 m/s, the dryer needs to be at least 8 m long. Drying systems therefore require considerable space. Due to dehydration, the paper web can become fragile and wavy and starts shrinking. Print finishing thus becomes more and more difficult. For this reason, *remoistening* with water is recommended for web offset printing presses. The water can either be sprayed onto the web or applied by rollers.

1.7.2 Chemical Drying/Curing

1.7.2.1 Oxidation

In offset printing on absorbing substrates, inks first dry by penetration (see sec. 1.7.1) and then by oxidation and polymerization. Final drying of the printing ink film is effected only by oxidation and polymerization of the drying oils and resins. The printing ink film receives appropriate cross-linking and consistency against rubbing-off and abrasion, it has, however, to preserve adequate elasticity for the product to be used.

Oxidative drying of offset inks containing drying oils is effected without additional units by molecular linkage with oxygen from the air. For that, the ink layer on the sheet to be linked should be supplied with sufficient oxygen in the delivery pile. The necessary space between the sheets can be increased by *powdering*, and oxygen can then diffuse in the piles. Powdering serves to support drying in the pile, and also to avoid smearing the image on the underside of the top sheet.

Even though accelerated by *catalysts* in the printing ink, drying by oxidation takes quite a while. Metallic soaps, that is, cobalt or manganese combined with oil-soluble acids, are used as catalysts.

Cobalt driers in the ink are "surface driers", that is, the drying process is started on the ink surface and slowly proceeds to the substrate. *Manganese* functions as a through-drier. Frequently, *compounds* are used as driers guaranteeing a straightforward drying process. There is an optimum quantity of *drier additive* for every ink/substrate combination. Adding too much additive can cause the ink to dry on the rollers of the inking unit. Transfer of ink onto the substrate is then likely to be disturbed.

Parameters influencing printing ink drying are:

- in the printing ink: pigment, vehicle, drying agent;
- in the substrate: pH value, coating composition, penetration behavior, water absorption, temperature in the delivery pile;

and in offset printing:

- dampening solution with: pH value, water salt content, water hardness, alcohol percentage.

Figure 1.7-5 shows the relevant spectrum of electromagnetic waves specific to ink drying. The IR radiation is of no direct significance for chemical (oxidative) drying. It is merely the elevation of temperature that brings about increase in reaction speed. However, UV radiation and ionizing radiation (electron-beam) in comparison produce radiation-linking chemical ink drying.

1.7.2.2 UV Drying/Curing

UV drying of printing inks (and varnishes) is based on radical polymerizable vehicles. UV inks with appropriate UV dryers are suitable for sheet-fed printing presses and web presses. Drying between the print units – inter-unit drying – (fig. 1.7-10) can be used to prevent a reversal of the ink splitting in the following inking unit. In flexographic and gravure printing, drying has to be carried out after each inking unit (e.g., straight (recto) printing and perfecting) because of the ink properties (ink trapping, etc.). Very often an overall drying becomes necessary after the last inking unit, possibly at a higher output rate.

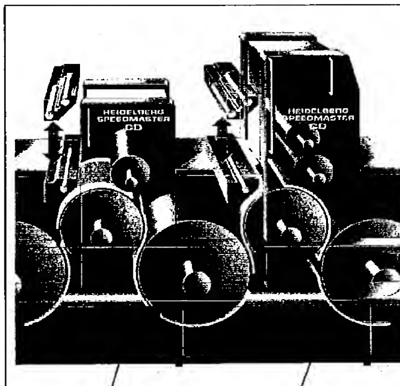


Fig. 1.7-10
UV inter-unit dryers for sheet offset printing press after printing unit and coating unit; UV dryer (blue) can be replaced by IR dryer (red), (IST Strahlungstechnik metz)

In case of UV drying, the ink film polymerizes and dries completely as soon as radiation occurs. Polymerization takes fractions of a second. The UV drying method, however, requires *special inks* containing completely different binders (vehicles) and additional photoinitiators (see sec. 1.5.2). The color black prevents UV radiation from penetrating in the ink layer and the curing effect is less than with chromatic colors or varnishes.

Conventional UV dryers work with one or several *mercury vapor lamps* (fig. 1.7-11, see also fig. 2.1-61). The wave length range lies between 100 and 380 nm. The system is enclosed by a reflector housing. Optimum cooling and extraction of generated ozone is necessary for the complete system. The units are designed in such a way that the permissible threshold limit value of 0.1 ppm (parts per million = one millionth of the volume of the substance in question, e.g., air) is not exceeded and damage (e.g., irritation to the mucous membrane) to one's health is prevented.

Excimer

The excimer radiator is a special type of UV lamp (fig. 1.7-12) with monochromatic light (mostly used with a wave length of 308 nm). Advantages of this radiator include:

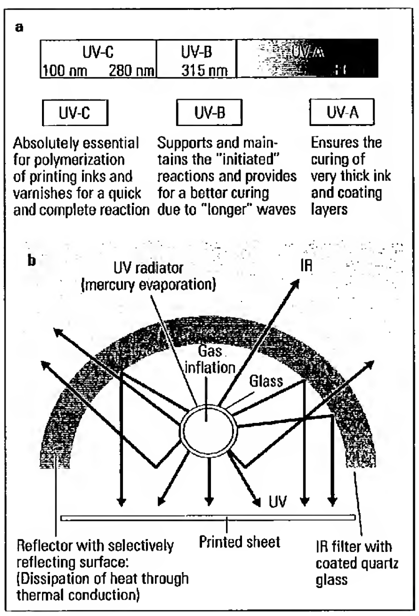


Fig. 1.7-11 UV drying system.
a Ranges of the UV spectrum and their effect;
b UV radiator reflector system (Dr. Hönle)

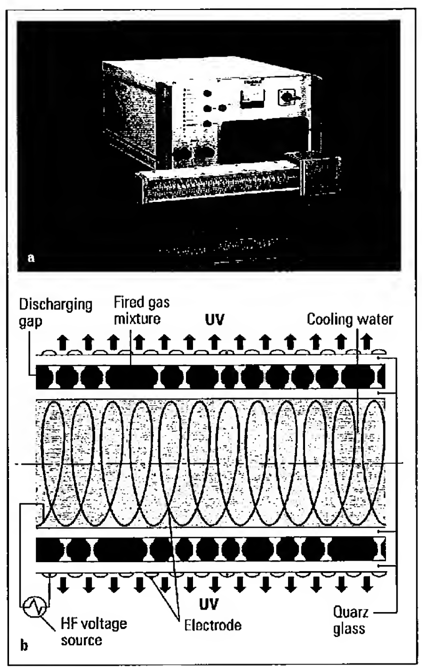


Fig. 1.7-12 Excimer radiator.
a Excimer system with radiation unit and ballast;
b Structure of an excimer radiator (Heraeus Noblelight)

- no heating of the paper as radiation does not involve any IR,
- no ozone generation at 308 nm,
- better utilization of electrical susceptibility for the drying process.

The disadvantages are:

- The power (up to 50 watts/cm radiator length) of today's excimer radiators is still considerably lower than the power density of mercury vapor lamps (up to 250 W/cm). If radiation takes place in an inert gas atmosphere (e.g., nitrogen), it will still result in the desired drying performance.
- The ink photoinitiator system needs to be adapted to the particular wave length. Conventional UV lamps are polychromatic and therefore cover a greater bandwidth of photoinitiators.

Excimer dryers are particularly interesting for flexographic printing in association with the printing of heat-sensitive substrates (e.g., foils). The pros and cons of UV drying are summarized in table 1.7.2.

1.7.2.3 Electron Beam Drying/Curing (EBC)

Electron beam is an *ionizing radiation* of such high energy that molecules in the vehicle of a printing ink are ionized, thus causing the release of free radicals. Today, electron beam drying is used with particular print products (e.g., food packages, due to the absolute drying of ink and the destruction of any micro-organisms in the substrate). Appropriate drying systems and inks are comparatively expensive.

In principle, the same vehicles and inks can be used for EBC and UV drying. Owing to high energy, a sufficient number of initial radicals are released in the vehicle itself; therefore there is no need to add expensive photoinitiators (resulting in better storage stability of the inks). It is, however, absolutely essential to use radiation in an inert gas since the presence of oxygen not only considerably impedes curing, but also leads to a radiation-induced, oxidative degradation of the ink layer and, possibly, of the substrate. If oxygen is excluded, the dose of radiation required for drying the ink layer only causes minimal damage.

With electron-beam drying no unwanted high heating of the substrate or the printing ink layer occurs. Figure 1.7-13 shows the possible arrangement of radiators.

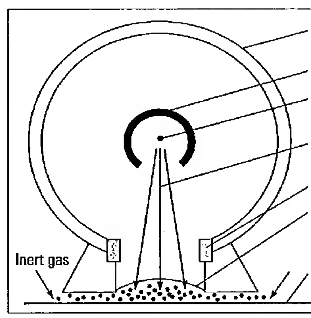


Fig. 1.7-13 Principle of electron-beam tube (MEC)

Table 1.7-2 Pros and cons of UV drying

Pros	Cons
UV inks are completely dry upon radiation	Higher capital investment due to accessory equipment
No damage to the prints by ink set-off or sticking	Higher costs for printing inks, washing agents, etc.
Immediate print finishing is possible (e.g., trimming, scoring, stamping, punching, etc.)	Relatively short service life of UV lamps
Printing on non-absorbent substrates (metal, foils) is not difficult	Less suitable for absorbing substrates
	Fogging/misting (due to the rheological properties of ink, e.g., tack) with UV offset inks results in a limiting of the printing speed

Table 1.7-3 Pros and cons of EBC drying

Pros	Cons
Immediate drying Radiated product stays cold	High investment costs X-radiation shield is a "must"
Simultaneous drying of both sides in recto/verso (perfecting) printing and radiation only from one side of the substrate (not possible for tin or metallic foils)	Radiation inside a protective atmosphere (e.g., nitrogen)
	Substrate is likely to get damaged if the radiation dose is too high
	Higher cost for printing inks

An electrically heated tungsten ribbon serving as an electron-beam source is admitted to the web.

The pros and cons of EBC (electron beam curing) drying are summarized in table 1.7.3.

1.7.3 Auxiliary Drying Techniques

As described in section 1.7.1, the drying process in conventional letterpress or sheet-fed offset takes place in two steps: penetration, followed by oxidative polymerization of the printing ink.

The penetration process is effected immediately on ink transfer in the printing zone. Penetration provides higher viscosity for the ink film lying on the substrate. Quite often, however, this hardening effect is not enough to avoid set-off effects and, in extreme cases, complete blocking (sticking) of the paper in the delivery.

1.7.3.1 Powder Spraying

The printed sheets in the delivery are *powdered* to avoid set-off or blocking effects (fig.1.7-14). The fine powder layer is distributed by compressed air, thereby preventing the ink of the freshly printed sheet from getting too close to the reverse side of the top sheet (fig. 1.7-15, see also fig. 2.1-56 for powdering on both sides with perfecting jobs). The colorless (white) powder grains serve as "spacers" ensuring oxidative drying by inclusion of air. These grains lying on the printed sheet provide an air cushion between the individual printed sheets. Grain sizes vary from 15 to 75μm (material: colorless mineral or vegetable based substances). As a general rule one can say that

- the rougher the substrate, the more coarse the grain should be,
- the thicker the ink layer, the more powder is needed.

Incorrect powdering can seriously affect the usually good print quality, in particular with regard to gloss.

Mineral and vegetable based powder types are classified as:

- *Calcareous* (mineral-based) spraying agents available in different graining. They are essential for cardboard printing.
- *Starch-containing* (vegetable-based) products based on corn. They are available in fine graining only and therefore suitable for processing papers of up to around 100 g/m² only. Since they are not as hard as calcareous agents, ink abrasion is considerably less.

The printing plates, too, are less affected by abrasion through soft (vegetable) powders. In multicolor printing, calcareous (mineral) powders deposit on the rubber blanket in the form of dust acting like sandpaper against the printing plate, thereby considerably reducing its service life.

1.7.3.2 Silicone Application

Coating the web in a commercial web offset press with a thin film of silicone oil-in-water emulsion prevents the products getting smeared in the folder. After printing, the ink beneath the silicon layer is not fully dry even after a few days and may still be smudged after the silicon layer has been rubbed off.

1.7.4 Measuring Techniques

The finishing of freshly printed sheets in particular requires sufficient abrasion resistance and pile resistance (no offsetting and blocking of sheets). For basic balancing between ink and substrate regarding ink

XI. RELATED PROCEEDINGS APPENDIX

There are no related proceedings or decisions rendered by a court or the Board of Appeals in any proceeding identified in the related appeals and interferences section in the pending application.